Mathematical Problems in Engineering

Hindawi

Special Issue on

Smart Planning, Operation, and Management of Water Supply Systems

CALL FOR PAPERS

Water supply systems (WSSs) are very complex structures to describe and operate, because of the nature of the classical hydraulic models describing WSS phenomena and due to the recent increased necessity to suitably handle huge amounts of data, which are generated in the various processes associated with water supply. Suitable design (in the case of new systems) and refurbishment (enlargement, rehabilitation, etc., at later stages) so that WSSs are able to provide the intended service are paramount; adequate monitoring to get enough quality judgment elements for (real-time) control is currently crucial; optimal operation to provide seamless quality service is vital; and finally, wise management able to reconcile such conflicting objectives as economic revenue and social satisfaction is a sine qua non of dealing with WSSs.

Efficient mathematical techniques are needed to cope with the complexity of the problems associated with WSSs. For example, in design and refurbishment tasks, robust and efficient optimization algorithms, able to deal with nonlinearities, mixed variables, and discrete processes, including those of an evolutionary nature, are paramount. Real-time monitoring of service quality will benefit from efficient techniques of time series data treatment, including a number of mathematical transforms. Operation may be defined in terms of a number of Boolean operators optimally defined and integrated into appropriate data structures, relying again on other types of optimization techniques. Finally, management is currently addressed through a wide spectrum of issues including demand forecast, network sectorization, leakage detection, cadastre maintenance, and consumer satisfaction assessment; widely used soft computing techniques, such as neural networks, support vector machines, clustering, agent-based systems, and social network theory, are expected to be robust and efficient. Additionally, in spite of the fact that some of the elements integrated in those issues are quantifiable, other may be classified as intangible. As a consequence, suitable techniques to treat information, frequently plagued with uncertainty and subjectivity, are also needed.

In the water supply industry, improvements in big-data computing to exploit data as fully as possible, for example, in Advanced Metering Infrastructures (AMI), will help reduce nonrevenue water in the near term. In the long term, such improvements will contribute, through more efficient operation, to the excellence of the urban water cycle, eventually propelling the implementation of the smart city concept from the water supply perspective. Further research is essential to develop algorithms that apply in real-world situations and on data sets with many elements.

In this special issue, contributions are sought that address mathematical developments that invigorate the application of the abovementioned procedures and techniques in the water supply field.

Potential topics include, but are not limited to:

Contributions addressing optimization techniques, efficient time series data treatment, definition of data structures and Big Data tools, neural networks, support vector machines, and other machine learning techniques, agent-based systems, graph theory and complex network methods, multiattribute decision making techniques, and other mathematical approaches, able to efficiently deal with the following problems:

Potential topics include but are not limited to the following:

- Smart water networks
  - Smart metering
  - Data analysis on top of metering data
- Online water distribution system analysis
  - Demand forecasting and look-ahead analysis
  - System state estimation
- Water quality sensor placement and event detection
  - Water quality sensor placement
  - Detection of contamination event
- Nonrevenue water reduction and operation optimization
  - Sectorization
  - Leak detection
  - Operation indicators, water balance, and benchmarking
  - Pump operation optimization (scheduling and rotation speed)

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